

Employment as butcher and cancer risk in a record-linkage study from Sweden

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Abstract

Objective: To investigate the risk of cancer among butchers and other meat workers in a large record-linkage study from Sweden.

Methods: The Swedish Cancer Environment Register III contains nationwide data on cancer incidence during 1971–1989 for all residents, by occupation and industry of employment as reported at the 1960 and 1970 censuses. We identified 25,049 men classified as butchers or meat workers at either census. We used as a comparison group the remaining part of the active male population, after exclusion of workers with direct contact with animals.

Results: Butchers in the meat industry had a slight increase in the risk of cancer (relative risk [RR] 1.1, 95% confidence interval [CI] 1.0–1.3), which was due to an increased risk of cancers of the oral cavity and pharynx (RR 1.6, 95% CI 1.0–2.7), stomach (RR 1.6, 95% CI 1.1–2.7), larynx (RR 1.4, 95% CI 0.6–3.4), and lung (RR 1.4, 95% CI 1.1–1.9). The risk of stomach cancer was highest during the first 5 years of the study, and among butchers from urban areas. No temporal or geographic variations were seen for lung cancer risk, with elevations restricted to squamous cell carcinoma. An increased risk of stomach, laryngeal and lung cancers was present in butchers and meat workers outside the meat industry. There was no clear indication of an increased risk of other neoplasms.

Conclusions: The increased risk of oral, laryngeal, lung and stomach cancers among Swedish butchers may be at least partly due to confounding by tobacco smoking, alcohol drinking, and other lifestyle factors. However, exposures in the meat industry (e.g., viruses, nitrosamines, polycyclic aromatic hydrocarbons) may contribute the elevated cancer risks.

Introduction

Several authors have reported an increased risk of lung cancer [1–6] and of lymphatic and hematopoietic neoplasms [2, 7–10] among butchers and slaughterhouse workers. Other studies, however, have failed to replicate the findings on lung cancer [11–14] or lymphatic neoplasms [4, 5, 13, 14]. An increased risk of other

neoplasms – including cancers of the oral cavity, esophagus, stomach and colon – has occasionally been reported. Occupational exposures of butchers and other meat workers include animal viruses, nitrosamines, polycyclic aromatic hydrocarbons (PAHs) and other combustion products [15, 16]. The number of specific cancers among butchers and related workers included in previous studies has been relatively small, and possibly subject to bias from selective reporting of certain neoplasms suspected to occur excessively.

Data from the Swedish censuses and national cancer registry provided a relatively large population of butchers and other meat workers to investigate the cancer risk in this occupational group.

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Methods

In 1960 and 1970, Statistics Sweden conducted two National Population and Housing Censuses. Information was collected through questionnaires on place of residence, demographic characteristics and employment status, job title and industry for all individuals in Sweden [17]. Individuals were followed up for cancer incidence and mortality during 1 January 1971–31 December 1989 through linkage with the National Register of Causes of Death and the Swedish Cancer Register. These linkages created the Cancer Environment Register III (CERIII).

Each cohort member contributed person-years of observation from 1 January 1971 until death or end of follow-up. For the purpose of this analysis we selected men who, at either census, were recorded as butchers or meat packers (Swedish occupational code 826) or as employed in butcher shops, meat processing or packing (Swedish industry code 200) and who were alive and free from cancer on 1 January 1971. Their age range at each census was 15–65; individuals who retired between 1960 and 1970 were included in the cohort. A total of 25,049 men classified as butchers or workers in the meat industry at either census contributed 379,421 person-years of observation. We excluded women from the study because of the small number of female butchers and meat workers. Men in the cohort were classified according to residence in one of four main regions of the country, and residence in large urban areas (Stockholm, Gothenburg, Malmö) vs. the rest of the country.

We created three main exposure categories. "Butchers in the meat industry" (occupational code 826 and industry code 200) comprise workers involved in slaughtering as well as in meat cutting and packaging in meat companies; owners of small-scale butcheries are also included in this group. "Butchers employed in other industries" include primarily meat cutters working outside the meat industry (*e.g.*, in department stores and other sectors of the food industry). Finally, "Workers other than butchers in the meat industry" include groups such as mechanics, maintenance workers, service workers, as well as white-collar workers. It was not possible to separate workers involved in slaughtering from other groups of butchers.

We calculated the expected number of cancers among butchers by applying the national incidence rates by gender and by 5-year age and calendar year group. For all neoplasms combined, and for specific neoplasms, we derived the standardized incidence ratios (SIR), defined as the ratio of the observed to the expected cases. Second primary cancers were included in the calculation of both observed and expected cases. We calculated the

95% confidence intervals (CI) assuming a Poisson distribution of the observed number of cases.

In addition, we conducted multivariate Poisson regression analyses [18] on the occurrence of selected types of cancer among butchers as compared to the rest of the employed male population included in CERIII, after the exclusion of other occupational groups with direct contact with animals: animal breeders, hunters, and veterinarians (219,000 person-years). The unexposed population contributed a total of about 40,224,000 person-years of observation. In the multivariate regression models, the experience of the cohort was stratified according to 5-year age groups and 4-year calendar periods, as well as region of residence and urban residence. We calculated relative risks (RR) and 95% CI of employment as butcher or meat worker. For this analysis we excluded second primary neoplasms and truncated the follow-up of subjects at the date of diagnosis of the first cancer. The experience of the study population is therefore slightly smaller than in the SIR analysis (372,504 person-years).

In further analyses to estimate duration of exposure, we restricted the exposed category to men who were employed as butchers or worked in the meat industry in both the 1960 and the 1970 censuses. We further restricted the exposed group to men who at both censuses had their job and industry titles in the aforementioned categories, thus identifying cohort members presumably at highest and longest exposure. The number of person-years contributed by men classified in the same categories at both censuses was 40,645 for butchers in the meat industry, 6723 for butchers in other industries, and 29,085 for meat workers other than butchers.

Results

The results of the follow-up of men identified as butchers or meat workers at either the 1960 or the 1970 census are reported in Table 1. A total of 2417 malignant neoplasms occurred in this population, which represented a significant 7% excess as compared to the experience of the national population. Cancers of the esophagus, rectum, larynx and lung, and non-lymphocytic leukemia, showed non-significant excesses of about 1.3. Among men employed as butchers in the meat industry at both censuses, we observed significant increases in overall cancer risk and in the risk of stomach and lung cancers. There was no suggestion of a difference in risk between the two censuses: the overall RR of cancer was 1.1 (1.0–1.2) if only the 1960 census is considered and 1.1 (1.0–1.2) if only the 1970 census is considered (details not shown).

Cancer

Table 1.
Register

Neoplasms

All cancer
Oral cavity
Esophagus
Stomach
Colon
Rectum
Liver, biliary
Pancreas
Larynx
Lung
Soft tissue
Melanoma
Skin, non-melanoma
Testis
Prostate
Bladder
Kidney, non-lymphocytic
Brain
Non-Hodgkin's lymphoma
Hodgkin's lymphoma
Multiple myeloma
Lymphocytic leukemia
Non-lymphocytic leukemia

n, number

Table
subjects
butcher
meat ind
elevated

Table 2.
Poisson re

Neoplasms

All cancer
Oral cavity
Stomach
Colon
Rectum
Larynx
Lung
Prostate
Kidney
Non-Hodgkin's lymphoma
Hodgkin's lymphoma
Multiple myeloma
Leukemia

n, number
excluding c

Table 1. Standardized incidence ratio of selected cancers among male butchers and meat workers in the Swedish Cancer Environment Register III

Neoplasm	Butcher or meat workers in 1960 or 1970			Butcher in meat industry in 1960 and 1970		
	n	SIR	95% CI	n	SIR	95% CI
All cancers	2417	1.1	1.0-1.1	347	1.2	1.0-1.3
Oral cavity, pharynx	73	1.1	0.8-1.3	14	1.5	0.8-2.5
Esophagus	38	1.3	0.9-1.8	1	0.2	0.003-1.4
Stomach	160	1.1	1.0-1.3	29	1.6	1.1-2.3
Colon	160	1.0	0.8-1.2	16	0.8	0.4-1.2
Rectum	142	1.2	1.0-1.4	20	1.3	0.8-2.0
Liver, bile ducts	44	0.9	0.7-1.2	5	0.8	0.2-1.8
Pancreas	78	1.1	0.8-1.3	11	1.1	0.6-2.0
Larynx	47	1.7	1.2-2.3	5	1.3	0.4-3.0
Lung	314	1.3	1.2-1.5	47	1.4	1.0-1.9
Soft tissue sarcoma	13	0.8	0.4-1.4	2	1.0	0.1-3.5
Melanoma	60	0.9	0.7-1.2	13	1.6	0.8-2.7
Skin, non-melanoma	90	1.0	0.8-1.2	9	0.8	0.4-1.5
Testis	18	0.8	0.5-1.2	2	0.9	0.1-3.1
Prostate	523	1.1	1.0-1.2	81	1.3	1.0-1.6
Bladder	191	1.2	1.0-1.3	23	1.0	0.6-1.5
Kidney, pelvis	78	0.9	0.7-1.1	15	1.2	0.7-2.0
Brain	52	0.8	0.6-1.1	10	1.2	0.6-2.2
Non-Hodgkin's lymphoma	66	1.0	0.8-1.2	8	0.9	0.4-1.7
Hodgkin's lymphoma	11	0.8	0.4-1.4	1	0.6	0.01-3.3
Multiple myeloma	30	0.8	0.6-1.2	3	0.6	1.1-1.8
Lymphocytic leukemia	36	1.2	0.8-1.6	4	1.0	0.3-2.5
Non-lymphocytic leukemia	33	1.3	0.9-1.8	4	1.2	0.3-3.2

n, number of cases; SIR, standardized incidence ratio; CI, confidence interval.

Table 2 shows selected results from analyses of subjects employed as butchers in the meat industry, butchers in other industries, and non-butchers in the meat industry. The RR for total cancer was significantly elevated among butchers in the meat industry (1.1), but

not among butchers in other industries (1.0) or among non-butchers (0.9).

The risk of lung cancer was elevated among butchers in the meat industry, but not among other groups. Stomach cancer risk was elevated among butchers in the

Table 2. Relative risk of selected cancers among subjects employed as butchers or meat workers at both the 1960 and the 1970 census - results of Poisson regression analysis

Neoplasm	Butchers in meat industry			Butchers in other industries			Non-butchers in meat industry		
	n	RR	95% CI	n	RR	95% CI	n	RR	95% CI
All cancers	312	1.1	1.0-1.2	47	1.0	0.8-1.4	229	1.0	0.9-1.1
Oral cavity, pharynx	14	1.6	1.0-2.7	2	1.3	0.3-5.1	5	0.7	0.3-1.6
Stomach	27	1.6	1.1-2.3	5	2.0	0.8-4.8	19	1.3	0.8-2.0
Colon	15	0.7	0.5-1.2	2	0.6	0.2-2.6	19	1.1	0.7-1.8
Rectum	17	1.1	0.7-1.8	1	0.4	0.1-3.1	10	0.8	0.4-1.5
Larynx	5	1.4	0.6-3.4	3	4.3	1.4-13.2	1	0.3	0.1-2.3
Lung	43	1.4	1.1-2.0	7	1.2	0.6-2.5	29	1.1	0.8-1.6
Prostate	73	1.2	0.9-1.5	6	0.6	0.3-1.4	53	1.0	0.8-1.3
Kidney	13	1.2	0.7-2.0	1	0.6	0.1-3.9	11	1.2	0.7-2.1
Non-Hodgkin's lymphoma	5	0.6	0.3-1.4	1	0.7	0.1-5.3	7	1.0	0.5-2.1
Hodgkin's disease	1	0.6	0.1-4.4	0	-	-	2	1.6	0.4-6.6
Multiple myeloma	2	0.4	0.1-1.7	2	2.7	0.7-11.0	4	1.0	0.4-2.7
Leukemia	8	1.1	0.5-2.1	0	-	-	8	1.3	0.6-2.5

n, number of cases; RR, relative risk adjusted for age, calendar period, geographic region and urban setting (reference category: other workers, excluding other animal-related jobs); CI, confidence interval.

Table 3. Relative risk of stomach and lung cancer associated with employment as butcher in the meat industry at both the 1960 and the 1970 censuses, by calendar year of incidence, geographic region and residence in urban setting – results of Poisson regression analysis

	PY	Stomach cancer			Lung cancer		
		n	RR	95% CI	n	RR	95% CI
Calendar period							
1971–74	9,660	7	2.5	1.2–5.2	7	1.6	0.8–3.4
1975–78	9,233	5	1.4	0.6–3.5	9	1.5	0.8–3.0
1979–82	8,627	6	1.5	0.7–3.4	6	0.9	0.4–2.0
1983–86	7,823	5	1.2	0.5–2.9	13	1.7	1.0–3.0
1987–89	5,302	4	1.3	0.5–3.6	8	1.5	0.7–2.9
Region of residence ^a							
Northern	4,780	4	1.7	0.7–4.6	5	1.9	0.8–4.5
Middle	11,476	7	1.4	0.7–3.0	18	1.8	1.1–2.8
Middle-South	15,066	10	1.6	0.9–3.0	10	1.0	0.6–1.9
South	8,202	5	1.3	0.6–3.2	10	1.3	0.7–2.4
Urban setting ^b							
Urban	28,515	22	1.8	1.2–2.7	28	1.5	1.1–2.2
Non-urban	11,143	5	1.1	0.5–2.6	15	1.3	0.8–2.2

PY, person-years of observation; n, number of cases; RR, relative risk adjusted for age, calendar period, geographic region and urban setting (reference category: other workers, excluding other animal-related jobs); CI, confidence interval.

^a A total of 1121 person-years were contributed by butchers who moved from one geographic region to another between the two censuses: they experienced one cancer of the stomach and no cancers of the lung.

^b A total of 987 person-years were contributed by butchers who moved from urban to non-urban setting or vice-versa between the two censuses: they experienced no cancers of the stomach or lung.

meat industry either at the 1970 census (RR 1.5, CI 1.1–2.0) or at both censuses (RR 1.6, CI 1.1–2.3; Table 2). Butchers employed in other industries experienced a two-fold non-significant increased risk of stomach cancer. There was also a small excess of stomach cancer among non-butchers. When subsites of stomach cancer were considered, the risk of cancer of the gastric cardia was particularly high among butchers in the meat industry (RR 2.6, CI 1.1–6.2; five cases).

The elevated lung cancer risk based on external comparison using Swedish cancer rates (Table 1) was confirmed in the multivariate regression analysis comparing butchers with other occupations, and was largely confined to butchers in the meat industry (Table 2). The risk was somewhat higher among men employed as butchers in the meat industry in 1960 only (RR 1.7, 95% CI 1.3–2.2) than among men employed in 1970 only (RR 1.4, 95% CI 1.0–2.0), although the confidence intervals overlap. Although the category included pleural cancers, there were few cases reported and their exclusion did not modify the results for lung cancer. Out of the 43 cases of lung cancer among butchers in the meat industry at both censuses (Table 2), 21 were squamous cell carcinoma (RR 1.9, 95% CI 1.2–2.8), two small cell carcinoma (RR 1.4, 95% CI 0.4–5.7), three adenocarcinoma (RR 0.7, 95% CI 0.2–2.0), and 17 other or unspecified types (RR 1.5, 95% CI 1.1–2.0).

The risk of laryngeal cancer was increased in the group of butchers or other meat workers employed at either census (Table 1), but the small number of cases of this neoplasm limited the utility of more detailed analyses (Table 2). The patterns of risk for prostate and kidney cancers did not suggest a relation with employment as butcher or in the meat industry. Similarly, there was no indication that the risk of lymphoma was elevated in any of the different groups of butchers or other meat workers, with the possible exception of Hodgkin's disease among other meat workers (SIR 1.6, 95% CI 0.4–6.6). The number of cases of multiple myeloma was too small for evaluation. No overall excess risk was found for leukemias overall in any group of butchers or meat workers.

Table 3 presents the risks of stomach and lung cancers specific for time period and residence. For stomach cancer, the risk was greater during the first period of follow-up and among urban residents, while no trend was suggested according to geographic region. Lung cancer risk showed no clear pattern by calendar period, region or urban/rural location.

Discussion

We found an increased risk of lung cancer among Swedish butchers, especially among those employed in

the meat industry. lung cancer was the excess, small, unspecified adenocarcinoma, a mode of butchers in our study. exposure including lines and identify early reported limited 1973 census (based on study by butchers between tion on next of (butchers cancer). None of animal cutting, packaging risk. Ho been lim would di the contr the fact our inve follow-up lung can detailed e et al. [15]. Our fin butchers studies [1- which had confound interpretin study of l increased smoking tious age suggested one study

the meat industry, while non-butchers in the meat industry had little excess risk. Although the number of lung cancers of specific histological types was small, the excess risk was largest for squamous cell carcinoma, smaller for small cell carcinoma and for other and unspecified histological types, and non-existent for adenocarcinoma. Several cohort studies have reported a moderate increase in the risk of lung cancer among butchers and meat workers, similar to the findings of our study [1-6]. Employment as butcher might entail exposure to known or suspected lung carcinogens, including polycyclic aromatic hydrocarbons, nitrosamines and animal viruses, but it has proven difficult to identify the specific agents. It should be noted that an early report by Fox and colleagues [1] overlapped to a limited extent with the present study, since they reported the incidence of lung cancer during 1961-1973 among Swedish men listed as butchers in the 1960 census (SIR 1.78 for butchers in the meat industry, based on 65 cases). Similarly, there is an overlap with a study by Gustavsson *et al.* which included 58 Swedish butchers at the 1960 census who died from lung cancer between 1971 and 1982 [15]. They obtained information on occupational history and smoking habits from next of kin of 45 of the 58 cases and of 230 controls (butchers who died from causes other than lung cancer) and evaluated relative risks by work area. None of the specific work areas assessed (*i.e.* live animal care, bleeding area, killing floor, or with meat cutting, processing, curing, smoking, chilling and packaging) was associated with increased lung cancer risk. However, information on job tasks may have been limited by non-differential misclassification that would draw the effect estimates toward the null, and the contrast in exposure opportunity was reduced by the fact that all study subjects were butchers. While our investigation expanded the population size and follow-up period, and considered neoplasms other than lung cancer, we did not attempt to replicate the detailed exposure assessment conducted by Gustavsson *et al.* [15].

Our finding of an excess risk of lung cancer among butchers in the meat industry is consistent with several studies [1-6] but not with others [11-14, 19-25], some of which had limited statistical power. Although potential confounding by tobacco smoking must be considered in interpreting the positive findings, a recent case-control study of lung cancer from Germany reported a two-fold increased risk among butchers after adjustment for smoking [26]. In addition to chemical exposures, infectious agents, such as papilloma viruses, have been suggested as a possible causative factor [27]. However, one study failed to detect in lung tumors human

papilloma virus type 7, which is commonly found in hand warts of butchers [28].

The excess of stomach cancer we observed among butchers has been previously reported in cohorts of English butchers [2], Swiss Pork butchers [4], and American poultry workers [14] and meat cutters [29]. In addition, record-linkage studies from New Zealand, Canada, the United States, Italy, and Finland have reported an increased risk of stomach cancer among butchers or meat cutters [3, 22-24, 30]. In contrast, other record-linkage studies from the United States, Denmark, and England and Wales have not observed an excess risk [13, 19, 31], nor have two small cohort studies of supermarket meat workers from the United States [5] and non-pork butchers from Switzerland [4]. In our study the excess risk of stomach cancer was highest among non-butchers in the meat industry and urban workers, suggesting effect modification by lifestyle or socioeconomic factors. An excess of stomach cancer might be due to nitrates used in meat preservation, with the endogenous formation of nitrosamines [32]. Since *Helicobacter pylori* is thought to play a causal role in stomach cancer, it is noteworthy that higher values of IgG antibodies against *H. pylori* have been observed among abattoir workers, suggesting possible transmission of *H. pylori* from animals to humans [33, 34]. Veterinarians and other workers in the meat processing industry in New Zealand also had higher titers of *H. pylori* IgG than control blood donors [35]. However, the high incidence of *H. pylori* among abattoir workers detected by ELISA could be due to antigenic cross-reactivity to large spiral gastric *Helicobacter*-like organisms common in the gastrointestinal flora of animals [36]. A Brazilian study comparing 160 abattoir workers with 160 asymptomatic blood donors found no difference in the prevalence of *H. pylori* [37]. A German study [38] showed that *H. pylori* from slaughtered chicken could be re-cultured from cutting boards as long as they were moist, indicating a possible source of infection to humans. It is of interest that we found no relative increase in risk among workers employed in 1960 only, which could be related to the higher prevalence of *H. pylori* in older birth cohorts, making it difficult to distinguish the risks among butchers from others in the population.

Our finding of an increased risk of cancer of the oral cavity resembles previous observations among American butchers [19], meat packers [6] and meat workers in supermarkets [5], but not among European workers [13, 23, 24, 31]. An increased risk of laryngeal cancer we observed is consistent with studies of self-employed butchers from Switzerland [4], butchers from New Zealand [3], and record-linkage studies from Italy [23] and Denmark [31]. However, the findings for oral and

laryngeal cancers are based on small numbers and could not be evaluated in greater detail.

We could not confirm the excess risks of lymphoma [2, 7–10, 22, 29, 39] and leukemia [3, 4, 7, 9, 10, 40] reported in previous studies of butchers and meat workers, although an excess risk of chronic non-lymphocytic leukemia was suggested based on small numbers. An increased risk among butchers has been occasionally reported for other tumors, including cancers of the esophagus [6, 14, 19], colon [4–6, 30], bladder [6, 30], liver [2, 4], prostate [4], kidney [6, 29], bone [6], and soft tissue [3, 9]. For none of these neoplasms did our results suggest a positive association.

The present study has several advantages: it was based on a very large cohort of Swedish male butchers, who contributed over 370,000 person-years of observation with almost complete follow-up for cancer incidence. The main limitation of our study concerns exposure assessment, which was based on self-reported occupation and industry at two points in time, the 1960 and 1970 censuses. The quality of data on occupational titles at the 1980 Swedish census was assessed by Warnryd and colleagues [41]. They compared an interview-based survey of 9000 men and women conducted in 1980 and 1981 with census data. The proportion of concordant occupational titles was 72%, suggesting reasonable quality of the census data. Given the prospective nature of our study, such misclassification is likely to have operated non-differentially with respect to cancer and to have diminished any excess risks. This is particularly unfortunate since previous studies reported a higher risk of lymphoma and lung cancer among butchers involved in slaughtering than in meat cutting [10, 25]. However, even if the census data are of good quality, the categories used for the analysis are fairly broad. It was not possible to distinguish between workers involved in slaughtering of animals, meat cutters and other groups of butchers. Similarly, it was not possible to separate various branches of the meat industry (beef, pork, poultry, etc.). We could however analyze butchers employed in the meat industry separately from other groups of workers. Although the category of butchers in the meat industry includes different groups of workers likely to have different exposure profiles, they are also likely to experience greater contact with fresh meat than other workers in the meat industry and other butchers. The results presented in Table 2 can therefore be interpreted as a crude dose-response analysis. Furthermore, it should be kept in mind that such misclassification of exposure would act toward reducing differences in cancer risk between groups of butchers with different exposures. Another problem in using census data is the lack of information on duration of

employment; this drawback was addressed by analyzing separately butchers and other meat workers who reported the same job or industry at both censuses. A third limitation of our exposure data concerns the lack of information on detailed job tasks and on exposure to potential carcinogens inside or outside the workplace.

Uncontrolled confounding by smoking or other factors might explain the observed increase in the risk of cancers of the lung, larynx and stomach in our study. Information on smoking habits, as well as occupational titles, is available in a random survey of 25,000 Swedish men conducted in 1963 [42]. In an analysis linking this cohort to the cancer register, workers in the food industry experienced an increased risk of lung cancer (SIR 1.3), which was partly due to increased tobacco consumption; the smoking-adjusted SIR was 1.2 (95% CI 1.0–1.4) [43]. In the small sample of butchers and slaughterhouse workers ($n = 74$) included in the 1963 survey [42], the prevalence of regular smokers was 72% among subjects aged 18–49 and 60% among those aged 50–69, as compared to 53% and 46% in the entire sample. In an earlier analysis of lung cancer data in this study, Hogstedt and colleagues reported an SIR of 1.8 for Swedish butchers and slaughterhouse workers employed in 1960 and followed up during 1961–1979, which was reduced to 1.3 after adjustment for smoking [44]. In addition, Swedish butchers have a 1.9-fold higher risk of having alcoholism listed as hospital discharge diagnosis than do employed men in general, which suggests that alcohol consumption might have contributed to the elevated risks of oral and laryngeal cancers in our study [45].

In conclusion, our study revealed an increased risk of cancers of the oral cavity, stomach and lung among Swedish men registered as butchers or workers in the meat industry at the 1960 or 1970 censuses. The risk of stomach cancer decreased during the period of the study and was present only among butchers from urban areas, while the risk of lung cancer did not vary by calendar period or geographic region. Although the patterns of cancer risk in the meat industry may be influenced by tobacco smoking, alcohol drinking and other lifestyle factors, workplace exposures may be involved to some extent.

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